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APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO.
10 034,497	12 29 2001	In Cheol Ryu	CU-2756 VE	1250

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224 SOUTH MICHIGAN AVENUE, SUITE 1200
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EXAMINER

QUACH, TUAN N

ART UNIT	PAPER NUMBER
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2814

DATE MAILED: 03 28 2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/034,497

Applicant(s)

RYU ET AL.

Examiner

Tuan Quach

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-19 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-19 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 29 December 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☒ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s) ____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) ____ 6) ☐ Other:

DETAILED ACTION

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1-4, 7-13, 16-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art taken with Ho et al.

The admitted prior art shows the formation of contact holes including through insulating layers 3 and 7 to form contact hole 11b and through conductor 5 and insulating layer 7 to form contact hole 11a as shown in Fig. 1 and the specification page 2 lines 10 to page 3 line 8. The admitted prior art thus lacks anticipation primarily in that it does not teach the use of CVD TiN and tungsten for conductor plugs.

Ho et al. teach the formation of tungsten plugs in interlayer dielectric including the provision of CVD titanium nitride barrier; the use of additional PVD titanium nitride

by plasma vapor deposition is also taught. See column 1 lines 21-50 and column 2 lines 36 to column 3 line 25.

It would have been obvious to one skilled in the art in practicing the admitted prior art process to have included the conductor plugs comprising CVD TiN including a PVD TiN and tungsten for such conductor plugs since such conductive structures are conventional and advantageous as shown in Ho et al. wherein tungsten plugs having improved characteristics over high aspect ratio openings can be obtained. The CVD TiN of the same material and deposition process would also function as the glue layer, absent evidence to the contrary, and as it is well known that such TiN would function as glue as well. It would have been obvious and would have been within the purview of one skilled in the art to have employed well known alternative conductive materials, e.g., as recited in claim 2, well known and conventional source for CVD TiN, e.g., as in claim 4, and well known and conventional etchant as in claims 7 and 8; alternatively, official notice is taken with regard to such conventional processing and materials. The provision of difference in depth, e.g., as in claim 9, would have been obvious as admitted in on page 3 line 8. The use of etchant having lower etch rate would have been apparent given the showing in Fig. 1 layer 5 and otherwise would have been obvious given the teaching of conventional etchants employed and conventional conductive materials being employed. The use of the PVD TiN before or after CVD TiN corresponds to two obvious alternatives and the selection of either one would have been obvious and would have been within the purview of one skilled in the art.

Claims 5, 6, 14, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art in view of Ho et al. as applied to claims 1-4, 7-13, 16-18 above, and further in view of Zhao et al.

The prior art as applied above do not recite the plasma treatment and the recitation of titanium.

Zhao et al. teach the plasma treatment of TiN including hydrogen and nitrogen to improve its quality. The inclusion of a titanium e.g., layer 106 with the titanium nitride, e.g., layer 108 is also shown. See column 3 lines 50 to column 4 line 32.

It would have been obvious to one skilled in the art in practicing the above process to have included the plasma treatment and the titanium layer since such is well known and advantageous as taught by Zhao et al.

Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art taken with Ho et al. as applied to claims 1-4, 7-13, 16-18 above, and further in view of Harshfield or Tsai.

The prior art is applied as above and do not recite thermal treatment as in claim 19.

Harshfield teaches rapid thermal treatment of TiN to stabilize the film by combining any residual reactants therein. See column 4 lines 3-8, lines 53-58.

Tsai teaches thermal treatment wherein titanium layer deposited can react to form silicide; the use of CVD TiN is also taught. See column 5 lines 21-40.

It would have been obvious to one skilled in the art in practicing the above process to have included a thermal treatment before or after the CVD TiN since such

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processing is well known and advantageous wherein improved TiN can be obtained and wherein titanium silicide can be obtained. RTP or tube annealing and annealing before or after correspond to two conventional alternatives for annealing and processing sequence and the selection of two possible alternatives would have been obvious.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Yano et al., Doan, Lee, and Marangon et al. teach metallization structures and processing of interest.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Quach whose telephone number is 703-308-1096. The examiner can normally be reached on M - F from 9 to 5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached on (703) 306-2794. The fax phone number for the organization where this application or proceeding is assigned is 703-308-7722.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

[Handwritten signature]